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JOURNAL
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DETAILS OF ARRANGEMENTS AND ORGANIZATION FOR THE USE OF CONVICT LABOR IN ROAD CONSTRUCTION

BY JOSEPH HYDE PRATT

Before taking up a discussion of the details of arrangements or organization for the use of convict labor in the construction of public roads, I wish to state briefly certain phases of the convict labor problem that are pertinent to the economic use of such labor. There are certain fundamental principles that must be borne in mind in considering this problem and in the handling of convict labor:

First: The convict is a human being and must be treated as such; he has a sense of responsibility, honor and discipline, and this sense can be quickened and developed.

Second: That perhaps with few exceptions, there is some good in every convict, which can be developed and made paramount in the character of the man.

Third: The convict in serving his sentence is simply paying a debt that he owes to the State for certain infringements of the laws of that State; and, when he has served this sentence, he has paid his debt and should be in a position to become a good and valuable citizen of the State. Most convicts are serving a first sentence and often for a crime committed on the spur of the moment, and with many of them this one crime committed represents the only black spot in their lives.

Fourth: Hard work is a good reformer, and idleness begets melancholia.

Fifth: The State on her part owes it to the convict to assist him in every way to pay his debt as speedily and economically

as possible, and in such a way that he is a better man when his debt is paid than when he was convicted.

Sixth: The attitude of the State toward the convict should be corrective and not vindictive; to uplift and not degrade him.

Seventh: To put a man in stripes often so degrades and humiliates him that it is extremely hard, and sometimes impossible, for him to reform.

Eighth: Outdoor work is much more conducive to good health and cheerful dispositions than confinement in prisons or factories with no outdoor exercises but what can be obtained in a limited area of a penitentiary yard or court.

Ninth: There must be an incentive before good work can be expected from most convicts.

Tenth: There is a great variation in the character and working ability of different convicts.

Eleventh: In many cases families were dependent upon the convict before his sentence and are, during his sentence, deprived of that support.

The first question that presents itself is whether the attitude of the State toward the convict should be to impress upon him that he has committed a wrong and therefore there is no good in him, and that this idea must be impressed upon him continually during the serving of his sentence; or whether the attitude of the State shall be that the convicted man in serving out his sentence is paying a just debt to the State, and that, while she insists the debt shall be paid and that in paying it the convict shall not forget that he is a debtor to the State, yet he may be able to eliminate as far as possible the fact that crime has been committed. Is it possible for the State to have this latter attitude toward the convict when they compel him to wear stripes—which in America universally denote the felon —have their heads shaved, and always walk in lock step when going from one part of the prison ground to another? These phases of a convict's life were formerly considered necessary in order to prevent his escape and were also considered as part of his punishment. They are degrading, and will wear out the

soul of many a man; and, to my mind, should only be used as a last resort and not as a first resort. I believe depriving a man of his liberty and requiring him to work for the State for a certain length of time according to the gravity of his crime is sufficient punishment for a very large majority of the men who are convicted.

At present, without going into the question as to what is the best work for the convict to do, I wish simply to make the general proposition that in any group of convicts it will always be found that some will do a great deal more and better work than others, that some will work very willingly and industriously; while others are lazy and only work the minimum amount that is required of them. This is especially true of a certain class, when they feel that they have got nothing whatever to gain by more energetic endeavors. Would it not then be the proper thing for the State to allow the convict a certain percentage of the value of his labor, which could be forwarded to his family, if he has one dependent upon him; or become accumulative and be given to him at the end of his sentence as a fund with which to start life anew.

The State is the guardian of every convict and she can make or break him according to the treatment she measures out to him. Her rules and regulations must be just, and then she must insist upon their strict obedience. On the other hand she must be just as strict to see that those she places in charge of the convict, whether it be Prison Warden, Superintendent, or Foreman, all keep faith with the convict and that all promises made to them of whatever character are kept. A promise to the convict is an obligation that the State must keep, and upon the strict carrying out of such promises and the strict enforcement of just rules and regulations will depend the success of the use of convict labor not only in road construction but for any other purpose.

Keeping in mind the suggestions and statements made above, I would submit for your consideration as a logical plan for the treatment and organization for work of the convict the following:

That the men who have been convicted and sentenced for the

first time all be considered as men capable of being treated in the most lenient way by the prison authorities. That they shall not be required to wear stripes or have their heads shaved, reserving this form of prison garb for those whom it is found cannot be trusted, and who will not live up to the rules and regulations of the prison authorities.

There could be three classes of convicts: Those in the *First Class* who are not required to wear startling or very noticeable uniforms; those in the *Second Class* who are required to wear a distinctive uniform but not stripes; and those in the *Third Class* who are required to wear stripes and, if necessary, have their heads shaved.

To the Third Class would be assigned those who have been convicted and sentenced more than once for some crime against the State, and those who, while serving out their sentence, are constantly breaking rules and regulations of the prison authorities.

To the Second Class would be assigned those who have started in the First Class but have shown that they will not obey all the rules and regulations or do good or efficient work and are not to be trusted; and for further infringement of the rules and regulations, they would be assigned to the Third Class. To this Second Class would come men from the Third Class who have shown by their work and their deportment that they are trying to live up to the rules and regulations and become better men. They in time might be able to be transferred to the First Class.

To the First Class would be assigned those who have been convicted for the first time, and they would remain in this Class until they have shown by their behavior that they are not to be trusted or will not do good and efficient work, when they will be assigned to the Second Class. In this First Class would be the men who would be known as "honor men."

In the South where a very large proportion of the men convicted of crime are negroes, it may not be possible to carry out exactly the above classification, as it may be necessary to assign the negro convict to the Second Class and make him show by his work and deportment that he is entitled to a place amongst the

"honor men." In the West and probably in the North where the negro convict is in the minority, it is possible to assign them at once to the First Class. To some it may seem that guns are necessary to control the negro convict, yet I believe it will be found possible to create in his mind the idea and realization that the serving out of his sentence is simply paying a just debt that he owes to the State, and that the State is really trying to better his condition and give him a chance to make something of himself again; and that this will develop in him a loyalty to the superintendent of the camp and the foreman under whom he works.

The convict force will be divided into the above classes regardless of the work that they are to do. The present paper, however, takes up the question of the use of this labor in the construction of public roads, which means the erection at various points of convict camps.

ORGANIZATION OF THE CONVICTS

The organization of this convict labor for road construction will be of two distinct methods depending upon the classes of convicts used:

First, would be the convicts that would be worked without guards and without stripes, representing the men of the First Class or "honor men."

Second, would be those over whom it is necessary to have armed guards while they are working, and would be convicts of the Second and Third classes.

The men of the Third Class would wear stripes and work under guards with guns, and the worst men of this class might have to be worked in stockades in breaking rock or doing similar work. Those of Class II would be worked under guards with or without exposed firearms, as the case might be. At night the convicts of Class III would be on chains and under armed guards, while those of Class II would be not on chains but under armed guards.

FIRST METHOD OF ORGANIZATION

The convicts in the first method of organization representing Class I or "honor men" would be divided into three groups, if the camp is of sufficient size, according to the work that the men are capable of doing. In the first group would be the most efficient men of the camp of whom would be expected a certain definite amount of work. The rest of the convicts of the camp would be graded into second and third groups. Knowing then what each group of men is capable of doing on an average as a day's work, the foreman of the road work could estimate what each group should easily be able to do in a certain time; and then, if the group were able by especially energetic work to accomplish more than the required amount, the men of that group should be allowed as a bonus a certain percentage of the value of the extra work that the group accomplishes, this to be paid in money and divided equally amongst them. The first group should be allowed 50 per cent; the second group, 40 per cent; and the third group, 30 per cent of the values of the extra work. The men should be permitted to spend this money at any time for things they wish that, of course, are not under the ban of the authorities.

As I have already stated, I believe that the convicts should be allowed a certain per cent of the value of the time that they are obliged to work for the State, the money thus earned to become accumulative and to be turned over to them at the expiration of their sentence; or to be turned over, if requested by the convict, at stated intervals to his family, provided that at all times there shall be a certain percentage of that earned by the convict to his credit in the Penitentiary Treasury. These two opportunities of actually earning money will be a very great incentive for the men to do better and more conscientious work and will also be an incentive for each man to see to it that each member of the group to which he is assigned does his part toward keeping up the record and reputation of the group. The amount allowed to convicts for their labor will vary according to the Class to which the convict is assigned. Those of the First Class should

receive a greater amount per day than that received by either of the other two classes; but each group of Class I should receive the same percentage. This would be a fair proposition inasmuch as the cost to the State of the men in the First Class is considerably less than those in the other two classes inasmuch as no guards are required and the men are on their honor. My idea is that no matter what the rate allowed per man be, the man of the First Class should receive one-third again as much as those in Class II; he, in turn, should receive one-third again as much as those in Class III. It will cause the men of the First Class to do their best to remain there, as they are able to earn more money; and it will be an incentive for the men of the third group to try to get into the second group, and for the men of the second group to get into the first group.

Those men of the First Class should also be receiving a commutation of their time. This varies in the different states, amounting to as much as ten days in one month in some states. If any man in Class I does not live up to what is expected of the "honor men" and breaks the rules and regulations of the camp, he may be reduced to a lower group; or, if his offense is very great, he may be reduced to Class II, and in the latter case he would lose what time has been commuted. If he attempts to escape he is to be reduced at once to Class III and will lose not only the time commuted but what money has been credited to him. Thus it will be seen that there is every incentive for the men in Class I to remain in that class; and I believe the men of that class will try and do their part to see that each one of the class lives up to what is expected of them. Those in Class II and III will see the great benefits that come to those in Class I, and will begin to do what they can to be transferred to Class I.

The accumulation of money that the convict has earned and the accumulation of time commuted from his sentence, which he knows will be lost if he attempts to escape or if he constantly breaks the rules and regulations of the camp, will be one of the strong motives that will prevent him from trying to escape; and, as will be seen later, this will also apply to the men of the Second and Third Classes. To my mind, however, one of

the strongest motives that will keep the men in Class I is the fact that confidence has been placed in them and they are trusted. It might be well at this point to state that any community that undertakes the working of convicts along the lines I am outlining must make it a point that *"honor men" must be "honor men" in every sense of the word.* There must be no guards of any sort. They must be housed, treated, worked, and fed similarly as in a military camp or perhaps in a railroad construction camp; differing from the latter, however, inasmuch as there would have to be certain rules and regulations similar to a military camp that the men must live up to; such as, retiring and getting up at certain specific times, being regular at meals, and other regulations that would be laid down by the Warden or Superintendent of the convicts. It is in this way that the convict realizes to the fullest extent the confidence that the State is placing in him and is believing that he will respect this confidence and pay his just debt by serving out his sentence.

SECOND METHOD OF ORGANIZATION

In this second method of organization where it is necessary to have the convicts guarded, the organization is somewhat different than in the first. In the first place we have two classes of convicts, one of which (Class III) are the men that have shown for the time being at best that they cannot be trusted in any way and have to be worked in stripes under armed guards and have to be chained at night.

Class II also has to be worked under guards, but it will be found that in some instances, as will be noted later, it will not be necessary that these guards carry exposed firearms. The men of Class II can be divided into two groups. Those of Group 1 would be considered men who are on probation before being transferred to Class I; and, while they are still worked under guards, it will not be necessary for these guards to carry exposed firearms. Group 2 would be worked under guards carrying exposed firearms but without chains. At night all the men of Class II would be in camp under armed guards. Those of group 1 would not be on a chain while those of group 2 would be. These men of Class II would wear some distinctive uni-

form, but not stripes. The men of Class II should be allowed a certain percentage in money of the value of their labor which, however, would be one-third less than that received by the men of Class I, and there would be no bonuses allowed for any extra work. The men in Group 1 of Class II would have the advantages over group 2 of not being under guards with exposed firearms, not being on the chain at night and being in direct line for transfer to Class I. This, I believe, would be incentive enough to keep these men from breaking the rules and regulations of the camp. Group 2 of Class II would know that by good behavior and good work they would be able to get transferred to Group 1 of the same class and in the end to Class I.

For infringements of the rules and regulations and for any attempt to escape, they would be punished similarly as stated for the men of Class I.

The men of Class III would be divided into two groups. Group 1 would be worked on the public roads but under guards and if necessary with chains. At night they would be under strict armed guards and on the chain. Those of Group 2 would be men whom it is not considered advisable to work on the public roads, and would be worked in stockades under armed guards and, if necessary with ball and chain. Those men could break rock for macadam, make cement drain tile, or other work that could be done in a stockade. With good behavior the men in Class III would be transferred from Group 2 to Group 1, and then from Group 1 to Class II, and so on to Class I. They would also be allowed for good behavior a commutation of their time and a certain per cent of the value of their labor in money. This, however, would be considerably less than that received by the men in Class II.

The one idea embodied in the above suggestions is that the rules and regulations of the camp and penitentiary authorities must be obeyed, but in obeying these the convict becomes entitled to and receives special consideration by the State.

The commutation of time would be the same for all classes of convicts provided, of course, that they are living up to the rules and regulations of the camp to which they are assigned.

The organization of the men who are to handle the convicts is of two-fold character: First, the men who take charge of the physical body of the convict; and Second, those who have charge of the labor of the convict.

The superintendent of the camp should have charge of the feeding, clothing, and guarding, when necessary, of the convict. He shall also be responsible for sanitary conditions of the camp and for the care of the sick. He shall provide the guards, when necessary, but these in no case should be permitted to act as foremen of the road work.

The superintendent of the construction work will have charge of the labor of the convicts, and he shall through his foreman direct such labor, and it shall be performed as he wishes it. He and the Engineer of road work of the State shall decide the amount of work that should be required of the convicts and determine what men shall be in the three groups of Class I. The division of the men into classes shall rest with the penitentiary authorities, but the superintendent of the work who comes in close contact with the convict may from time to time recommend changes, and shall report the refusal of any men to work as directed, which would constitute an infringement of the regulations of the camp.

It would not be necessary to work all the "honor men" of Class I in one camp, but certain numbers of these can be transferred to other camps where they would have special sleeping quarters, and would do such work as blacksmithing, bridge and culvert work, and other work where only one to three men are required and where it would be very expensive to provide a special guard for such a small number.

The question comes up and is often asked: Can long-term men be put on their honor and, as in the suggested organization, be placed in Class I; Can they resist the temptation to escape? I believe many long-term convicts can be worked as "honor men" and in Class I of the suggested organization. I believe that with a large percentage of them there would be less yielding to the temptation to escape if they were in Class I than if they were in Class II or III under armed guards.

These questions, however, of classification are settled by the

warden or superintendent, and they can usually determine pretty accurately who should be trusted. As I have already stated, except in extreme cases, I believe men sentenced for the first time can be started in Class I (with perhaps the exception of the negro convict). By personal contact, the prison and jail wardens come to know the prisoner and to know something of his character. I believe another good plan is for the superintendent and warden to get in touch with the prisoner's kinsfolk and get them in sympathy with the work of the prisoner and in having him serve out his sentence.

The prisoner's family should be encouraged to keep in touch with him, and should be permitted to visit him at stated intervals, and thus encourage him in every way to pay as rapidly as possible his debt to the State and encourage him in the feeling that there is a place for him when his sentence expires.

CONVICT CAMP

The convict camp will vary in its construction according as it is to be occupied by men of Class I or by men of Class II or Class III. If the camp is to be occupied entirely by men of Class I it can be established very similarly to a railroad construction camp. And there is no need of my going into any description for such a camp, except to state that it must be sanitary.

Wherever the camp is located and by whatever class of convicts it is occupied, it must be kept in a sanitary condition, supplied with pure water, and facilities provided for the men to bathe. All camps should be under the supervision or inspection of the State Board of Health.

Where camps are to be occupied by men of Class II, there are many plans that are in use for accommodating and taking care of the men. One camp I might describe used by State convicts in North Carolina, who are working a road in Henderson County, would be descriptive of one type of camp.

This camp, which is located near Bat Cave on the bank of Broad River, Henderson County, consists of a bunk house, or, as it is sometimes called, a "cell house" 30 x 60 feet, in the center of which is a double deck platform called the cell, upon

which are arranged the beds of the convicts. There is a clear space of 12 feet between each end of the building and double platform, and 6 or 8 feet clear between the cell and side walls. The space between the two platforms is approximately 5 feet. Each man is allowed a single mattress, so that he has plenty of room for sleeping purposes. Four chains run the length of the platform cell: one each side for the lower tier and one each side for the upper tier. To these chains the convict is fastened by a light weight ankle chain at night. This is so arranged that there is little or no weight on the ankle and he can turn in any position he wishes while sleeping. The construction of such a bunk house depends on the time of the year and length of time it is to be occupied; but it is always built so that there is plenty of air circulating through the building and that it may be kept warm and comfortable in cold weather. Guards are on duty in this building at night, one at each end.

Near to this building is the dining hall, kitchen, and store house. Surrounding these two buildings and enclosing an area of about one-fifth of an acre is a six-strand barbed wire fence. Just outside of this fence at opposite corners armed guards are stationed during the day. At night the only guards are within the bunk house. The sleeping houses for the superintendent, steward, and guards are a little distant from the enclosed area. The food supplied to the prisoners is the same quality as that supplied the guards and the steward. It is necessary that pure, wholesome food, clean and well-cooked should be furnished the prisoners, and that is what this camp tries to do.

In a camp of this sort, the men of Class II would have free run of the building and of the area within the fence during the daytime, but at night those of Group 2 would be fastened to the chain, while those of Group 1 would not. Cots could be substituted for the platform but in that case only one-half of the number could be accommodated, increasing the amount of floor space required and the number of guards.

Another type of camp is of tents with one platform along each side of the tent with a cleared space of about 10 feet between the two platforms. Where a camp is to be moved fre-

quently, the tents are very convenient as they are easily taken down, transported and set up again.

The bunk house or sleeping quarters of the Virginia convicts consists of a canvas tent or tent shaped building of sheet iron. Two rows of cots are placed in the center of the tent, and the men sleep with their feet toward the center. Along the line of cots is a long chain to which the convict is fastened by light weight chains.

As these road camps have to be moved at frequent intervals, it is economy to have them constructed in such a manner that they can readily be taken down, moved, and set up again.

Although the convict camps are to be under the supervision of the State Board of Health and certain definite rules regarding sanitation, cleanliness, etc., will be enforced; yet there should be a physician who would visit the camps every so often and examine the men to observe their physical condition. Where no such physician is employed by the State, for this purpose, arrangements should be made with a physician living in the vicinity of the camps to do this work. Every effort should be made to keep the men in good health and no pains should be spared to this end. The men, realizing that their health is being looked after by the State, will be more and more impressed with the idea that the State is trying to make men out of them, and will do more themselves to carry out the policy of the State in regard to its treatment of its convicts.

There should also be a Chaplain to look after the spiritual welfare of the convicts, and it is a good plan for the State to employ a regular Chaplain for this purpose. It will, of course, be impossible for one man to visit all the camps or convicts each week, but he could readily arrange with clergymen in the vicinity of the camps to hold religious services every Sunday. I do not believe in making attendance on these meetings compulsory, but am confident that a very large majority of the men would attend such Sunday services.

As stated above, the sanitary conditions of the camps of all the classes should be very carefully looked after, and the mattresses, bedding and clothing kept clean. But in addition to this the convict should be encouraged in every way possible to

keep himself neat and his individual part of the bunk house neat and trim. Chairs and benches should be provided around the bunk house.

Reading matter should be provided, and it will be found that a considerable proportion of the convicts will appreciate this very greatly. Donations of magazines can readily be obtained, to be sent regularly to the camps. Circulating libraries can, at little expense, be secured.

Colorado is a State that is using convicts of Class I in public road construction, but as yet is not using convicts that will correspond to Class II.

Virginia is working her convicts as Class II with the two groups. At nearly all the Virginia convict camps, there are a certain number of " trusties " that are trusted absolutely, representing Group 1, and the balance of the convicts represent Class II.

The difference in the cost of the work is all in favor of Colorado.

CHAPEL HILL, N. C.

THE CONDENSATION OF VANILLIN AND PIPERONAL WITH CERTAIN AROMATIC AMINES*

BY ALVIN S. WHEELER

In extension of the work done in this laboratory upon the condensation of chloral with aromatic amines,† we have carried out the condensation of the aldehydes, vanillin and piperonal, with *p*-aminobenzoic acid, its ethyl ester, and also with *p*-anisidine. Pawlewski‡ has described the product obtained by the condensation of anthranilic acid with vanillin, stating it to be an amorphous substance. We find that the para acid yields with vanillin a crystallin product with a melting point 40° higher. The condensation of anthranilic acid with piperonal was carried out by H. Wolf.§. Our product with the para acid melts 44° higher. The products with the ethyl ester have very much lower melting points. The work with the ester was undertaken with the hope of discovering more cases of isomerism, a few cases having already been observed in similar reactions. No indications of isomerism, however, were noted in handling the two ester derivatives.

The condensations take place readily in a boiling solvent with the loss of one molecule of water, one molecule of each constituent taking part in the reaction. By working at low temperatures it is sometimes possible to bring two molecules of the amine into combination with one of the aldehyde. In the reaction between the free para acid and piperonal a small quantity of a low melting substance, m. 171—3°, was isolated and the amount was greatly increased by using two molecules of the acid. Notwithstanding many analyses, no satisfactory figures could be obtained for a dibenzylidene derivative.

The condensation product of *p*-aminobenzoic acid with vanillin is unique among the benzylidene derivatives in that it is the only one that takes up a molecule of water of crystallization. Exposed to a moist atmosphere it gradually assumes a reddish

* Reprinted from the Journal of the American Chemical Society, Vol. XXXV. No. 8. August, 1913.

† Wheeler and Weller, THIS JOURNAL, 24, 1063 (1902). Wheeler, *ibid.*, 30, 136 (1908). Wheeler and Jordan, *Ibid.*, 31, 937 (1909).

‡ *Ber.*, 37, 596 (1904).

§ *Monatsh.*, 31, 903.

color. If it is recrystallized from water, it becomes brilliant red. It is not a case of isomerism, for it loses one molecule of water at 100° and regains its yellow color.

EXPERIMENTAL PART

3-Methoxy-4-hydroxybenzal-p-aminobenzoic Acid, $CH_3O.OH.C_6H_3CH:NC_6H_4CO_2H$, is prepared by boiling 1.37 grams (one mol) *p*-aminobenzoic acid and 1.52 grams (one mol) vanillin in 100 cc. toluene with the addition of 5 cc. alcohol. A little alcohol greatly diminishes the amount of toluene required. After boiling five hours under a reflux condenser, the solution is allowed to cool, the condensation product crystallizing out abundantly. A second crop of crystals from the mother liquor increased the yield to a total of 2.6 grams or 96% of the theoretical. The crude product, which melts at 204-6° was recrystallized from 200 cc. of toluene. The pure substance is deep yellow, consists of thin plates and melts at 211—2°.

Calculated for $C_{15}H_{13}O_4N$: C, 66.42; H, 4.80; N, 5.15
Found: C, 66.44; H, 5.12; N, 5.69

It was noticed that the rich, yellow crystals were often mixed with red ones. The first thought was that an isomeric compound was present, since some cases among analogous compounds are known, as the *o*-hydroxybenzalanthranilic acid described by Wolf. The whole mass turned red however in water and upon recrystallizing from boiling water a brilliant red substance, m. 104—6°, was obtained. After complete drying in the air, the product was heated to constant weight at 100°.

1.7860 g. lost at 100° 0.1150 g. H_2O.

Calculated for $C_{15}H_{13}O_4N.H_2O$: H_2O, 6.22; found: H_2O, 6.44.

3-Methoxy-4-hydroxybenzalethyl-p-aminobenzoate, $CH_3O.OH.C_6H_3CH:NC_6H_4CO_2C_2H_5$, is prepared by boiling 1 gram-molecule of ethyl-*p*-aminobenzoate with 1 gram-molecule vanillin in 10 cc. benzene for six hours under a reflux condenser. The solvent was then evaporated off and the residue recrystallized three times from alcohol. The crystals, which are thin yellow plates, melt at 145° (cor.).

Calculated for $C_{17}H_{17}O_4N$: C, 68.18; H, 5.73
Found: C, 68.53; H, 5.79

3-Methoxy-4-hydroxybenzal-p-anisidine, $CH_3O.OH.C_6H_3CH:NC_6H_4.OCH_3$, is prepared by boiling 1 gram-molecule of *p*-anisidine with 1 gram-molecule vanillin in 10 cc. benzene for six hours. Then after evaporation of the solvent, the product is recrystallized from ligroin. The pale yellow crystals deposit in radiating clusters, are easily soluble in most organic solvents and melt at 133.5° (cor.).

Calculated for $C_{15}H_{15}O_3N$: C, 70.00; H, 5.88
Found: C, 69.96; H, 6.09

3,4-Methyleneoxybenzal-p-aminobenzoic Acid, $CH_2 : O_2 :C_6H_3CH : NC_6H_4CO_2H$, is prepared by boiling 1.50 gram (one mol) piperonal and 1.37 grams (one mol) *p*-aminobenzoic acid in 100 cc. toluene for nine hours under a reflux condenser. The time was increased in this case to reduce the amount of a by-product melting at 171—3°. The chief product, which crystallized out on cooling, consisted of pale yellow prisms and could be recrystallized from toluene or water. The pure substance melts at 233—4°.

Calculated for $C_{15}H_{11}O_4N$: C, 66.90; H, 4.08
Found: C, 67.14; H, 4.64

If in the preparation of this compound the boiling was interrupted after two or three hours, a small amount of a substance melting at 171—3° could be readily islated. The amount could be greatly increased by employing two molecules of the acid for one of the aldehyde, but no satisfactory analytical figures could be obtained for a product containing two acid residues, in spite of many analyses.

3,4-Methyleneoxybenzalethyl-p-aminobenzoate, $CH_2 : O_2 :C_6H_3CH:NC_6H_4CO_2C_2H_5$, is prepared by boiling 1.50 grams piperonal and 1.65 grams ethyl-*p*-aminobenzoate in 10 cc. benzene for six hours. The product crystallizes poorly from benzene so the latter is evaporated off. Out of ligroin the compound crystallizes readily in long, pale yellow, glistening needles which melt at 109° (cor.).

Calculated for $C_{15}H_{13}O_3N$: C, 68.66; H, 5.08
Found: C, 68.96; H, 5.04

3,4-Methyleneoxybenzal-p-anisidine, $CH_2 : O_2 : C_6H_3CH : NC_6H_4OCH_3$. The condensation of piperonal with *p*-anisidine is carried out exactly as that of vanillin with *p*-anisidine. The product crystallizes well from ligroin or benzene. The crystals are very pale yellow needles, which separate in feathery groups. Melting point, 117.5° (cor.).

The experimental work here described was carried out by Mr. L. E. Stacy, Jr., and Mr. L. B. Rhodes and I wish to thank them for their careful work.

CHAPEL HILL, N. C.

COLOR AND STRUCTURE IN ORGANIC COMPOUNDS*

BY W. L. JEFFRIES

The very large number of organic compounds which are colored and the important place the dye stuffs occupy in modern industry have naturally caused chemists to seek some explanation of the color in compounds and just what relation the color bears to the structure.

In 1876 O. N. Witt offered the theory that color in organic compounds is due to the presence of certain unsaturated groups which are termed chromophores. The most important of these groups are the following:

C=C, C=O, C=S, C=N, N=N, N=O, $N\begin{matrix}O\\ \diagup\!\!\diagup\\ O\end{matrix}$. The ortho- and para-quoinoid radicals,

ortho-quinoid

para-quinoid

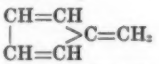
which may be regarded as a compact arrangement of the C=C group, were later added to the list.

A carbon complex containing such a group or chromophore is termed a chromogen. The chromogen may or may not be colored. If colorless it is necessary to introduce some salt-forming group such as NH_2 or OH. A group of this character is termed an auxochrome. For example, benzophenone, $C_6H_5.CO.C_6H_5$, although colorless is a chromogen since it contains the C=O group. On the introduction of the auxochrome, NH_2, to form aminobenzophenone, the compound becomes yellow. Similarly the nitro group is the chromophore of the chromogen nitrobenzene which forms the coloring matter of nitraniline.

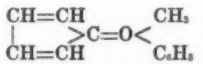
Color, depending on the chromophore, is intensified by its

* A report read at the January meeting of the N. C. Section of the American Chemical Society.

reduplication. For example hydrocarbons of the ethylene series, diphenyl- and tetraphenylethylene are colorless but diphenylhexatriene, $C_6H_5.CH:CH.CH:CH.CH:CH.C_6H_5$, is yellow. Absorption of color in the visible spectrum and the production of color seems to be promoted by the compact arrangement of double linkages in the ring structure. An example of this is the series of colored hydrocarbons discovered by Thiele and known as fulvenes.



Fulvene—yellow liquid



Methylphenylfulvene—orange liquid

Being isomeric with fulvene and containing the same number of double linkages, it might be expected that benzene would be colored. That it is not may be accounted for by the difference of the grouping of the double bonds which cause the absorption bands to shift within the ultra violet region of the spectrum. It seems certain that the $\begin{matrix}=C\\ \\ =C\end{matrix}\!\!>C=$ group is an important factor in color production. The influence of ring structure in deepening color is shown in flourenone,

which is red while benzophenone is colorless. Reduction or replacement by chlorine and sometimes hydration of the CO group destroys color.

Although the color effect of the C=O group is not apparent in the simple aldehydes or ketones or even in compounds where the C=O groups are separated such as acetylacetone, $CH_3.CO.CH_2.CO.CH_3$, a continuity of these groups does produce color. To illustrate, diacetyl, $CH_3.CO.CO.CH_3$, is yellow and the anhydrous triketone $CH_3.CO.CO.CO.CH_3$, is orange. The color appears to deepen with the increase in the number of C=O groups.

The C:S group appears to have greater effect as a chromophore than the C:O group as instanced by comparing tetramethyldiaminothiobenzophenone, $CS[C_6H_4N(CH_3)_2]_2$, which is yellow while the corresponding ketone is colorless.

The chromophore effect of the N=N group is illustrated in the numerous azo dyes. It is peculiar to note that in the case of the azo group, ring structure seems to diminish rather than to intensify color. The blue or green effect which most of the nitroso compounds exhibit may be attributed to the N=O group. The absence of color in certain compounds containing this chromophore may be explained by the bimolecular structure and consequent saturation of valencies.

From a study of compounds containing the chromophores it seems that they may be divided into two classes, those such as N=N and N=O which produce color independent of the nature of their environment and are therefore called independent chromophores, and those such as C=O and HC=CH which act only in conjunction with other groups and hence are called dependent chromophores.

That a slight difference may have a marked effect on the color of a compound is shown by certain stereoisomers such as the two dibenzoyl ethylenes, $C_6H_5.CO.CH:CH.CO.C_6H_5$, one of which is colorless and the other yellow.

As has been stated above, a compound containing a chromophore may not be colored and the introduction of an auxochrome may be necessary to produce color. The introduction of an auxochrome into a compound already colored serves to intensify the color. Of the two chief auxochromes, OH and NH_2, the latter seems the stronger as shown by a comparison of para-nitrophenol and para-nitraniline. It is worthy of note that both groups possess residual affinity and like the chromophores are highly reactive. It has been suggested that there may be an interaction of the two kinds of groups to produce a banded spectrum when light is absorbed.

The color of a compound is deepened or intensified by the replacement of hydrogen in the NH_2 by alkyl or aryl radicals, and as the molecular weight of the radical is increased the absorption is shifted towards the red. If the hydrogen of the OH group is replaced by a radical, it may either intensify or diminish color. It might be expected that the relative position of the auxochrome to the chromophore would have marked effect on the color. But the fact is that the closeness of the auxo-

chrome to the chromophore as frequently destroys color as intensifies it but Kauffmann concludes that when the auxochrome is attached indirectly to the chromophore by an aromatic nucleus which can function as a chromophore, the color is intensified.

Kauffmann, in a variation of the foregoing, offers what is sometimes called the auxochrome theory. He considers that those substances which at atmospheric pressure have the property of luminescence possess certain characteristics in common which form the basis of color. Luminescent compounds are mainly benzene derivatives and contain certain groups which Kauffmann terms luminophores. Benzene is regarded as the seat of luminescence. Benzene itself is only feebly luminescent but the effect may be intensified by the introduction of an auxochrome, by the multiplication of aromatic nuclei, or by linking nuclei with unsaturated carbon chains. Benzene is optically colored for it produces in the ultraviolet a banded spectrum. The effect produced by the introduction of auxochromes is to shift the absorption toward the red and thus produce color. Some of the absorption bands of nitrobenzene lie just within the visible spectrum so a weak auxochrome produces visible color.

Hantzsch has advanced a theory of color in compounds which has become known as the theory of chromoisomerism. His theory has been developed principally from observations concerning the nitrophenols in which the chromophore, NO_2, is alone too weak to produce color until reinforced by the auxochrome, OH, the chromogenic character of which is intensified by conversion into the salt. Hantzsch holds that all true nitrophenols and their derivatives are colorless. For instance dinitroethane $CH_3CH(NO_2)_2$, is colorless but on the formation of the sodium salt, which is deep yellow, there is a change in the form to $CH_3C(NO_2)NO.ONa$ called the *aci*—form corresponding to the pseudo acid and acid forms of phenylnitromethane. He expresses his general idea thus: "Every appearance of color or change of color in salt formation with a colorless metallic ion is due to isomeric change." The process of isomeric change he terms chromotropism. The attempt to extend the theory by further experimental observation has only

rendered the issues more complex and the explanations more involved.

Hartley offers a theory in explanation of color which is markedly different from any of those discussed above. In a discussion of his theory he says, "color may be visible or invisible, but a visible color is one which causes absorption of any rays with wave lengths not less than 3933, the more refrangible rays in the violet H_1 and H_2, and not greater than 7951, the deep red rays of rubidium."

As stated earlier benzene shows a series of narrow absorption bands in the ultra-violet and these bands become displaced towards the visible region of the spectrum by the introduction of certain groups. Hartley contends that when two or more benzene nuclei are fused or an auxochrome such as OH or NH_2 is introduced into the nuclei there is a displacement of the bands towards the visible region of the spectrum. Hartley's theory is that the fusion of the nuclei or the introduction of an auxochrome brings about a retardation of the period of molecular vibration or damping of their oscillation; that is the absorption bands are shifted towards the red. A chromogen is regarded as an invisibly colored substance and a chromophore as an atom or group which reduces the speed of vibration so that there is an absorption of rays within the region of visibility. While the linking of benzene nuclei may not produce color, it does reduce vibration and bring therefore the absorption bands nearer color. For example, triphenylmethane, though colorless or pale yellow when fused, produces a broad band of the same general character as benzene but of greater intensity and much nearer the margin of the visible spectrum. It is therefore a chromogen. Para-nitrophenol absorbs faintly in the violet and possesses a green tint though apparently colorless. When it is converted into its sodium salt, the absorption shifts towards the visible spectrum. There is not, as Hantzsch's theory would require, any change of structure. Formanek has studied a large number of dye stuffs and the relation of color to structure in them. He concludes that coloring matters which have analogous structure possess similar absorption spectra and the same is true of those which have the same chromogen and the same number of

auxochromes, $C_6H_5NR_2$ or C_6H_4OH groups. If the chromophore is different or if, with the same chromophore the number of $C_6H_5NR_2$ groups vary, or if the position of the auxochrome varies in its relation to the fundamental element, the absorption curve is different.

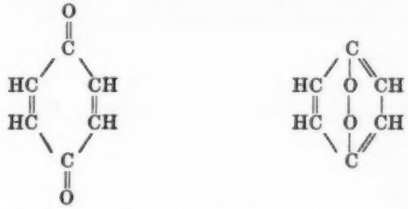
Hartley states as a rule, " all open chain hydrocarbons exert a continuous absorption, the extent of which is dependent upon the number of atoms in the molecule." Hydrogen is the most colorless substance known, which fact Hartley explains by saying that the rate of vibration of its atom or its molecule is the most rapid of all elements. This may be attributed to the fact that its mass it much less than that of any other element—perhaps its rapid vibration may be due to the large amount of energy associated with the molecule. That hydrocarbons are the least colored of all carbon compounds is due to the energy of the hydrogen atoms being communicated to the whole molecule. This may account for hydrogenized matters becoming colorless. The greater the proportion of hydrogen the faster the vibration. Naturally the introduction of a heavier atom or group in place of the hydrogen will lower the rate of vibration and bring the absorption nearer the visible spectrum; sufficient damping will produce color.

Armstrong has advanced the theory that the production of color is dependent upon special modes of atomic arrangement, and particularly on such modes as involve the existence of a condition of strain in the resulting system due probably to the peculiarities in the affinity relationships of the different constituent elements of the system which prevent mutual neutralitation of the affinities. The occurrence of color would then more frequently than not be concomitant with a high degree of reactivity, the colored compound being one of high potential or slight stability. The dominant feature of the arrangement is a comparison of the unsaturated hydrocarbons with the paraffins. The paraffins, which are singularly inert and all but colorless, contain carbon atoms united by single bonds. The unsaturated hydrocarbons begin to manifest color in the regions above and below the visible spectrum. These compounds are

represented by formula in which the carbon atoms are united by double or triple bonds.

Wm. J. Hale explains color as being due in both aromatic and aliphatic compounds to the oscillations of the bonds within the molecule and this he calls isorropesis. His theory is that a change in linkage produces the absorption bands. This he illustrates by diacetyl in which the make and break may be shown thus:

The make and break contact between the oxygen atoms would give marked activity to these atoms. The color in quinoid compounds is due to isorrepsis in this manner:



Isorropesis occurs between adjacent carbon atoms possessing residual affinity and the para carbon atoms are considered as possessing the relationship as indicated by their chemical behavior which is as if the atoms lay next each other. Isorropesis need not always occur between oxygen atoms possessing residual affinity but other atoms may show similar reactions. For example the nitranilines, $H_2N\text{-}C_6H_4\text{-}NO_2$, given an absorption curve similar to that of para-benzoquinone. Here the residual affinities of the N atoms are disturbed by the motion of the benzene molecule. In compounds of the benzene structure, the cause of the color begins with the vibration of the molecule itself.

The presence of other groups may augment or retard the influence of unsaturated atoms undergoing isorropesis and consequently the corresponding variations in the oscillation frequency will be indicated by similar variation in the nature of

the color. Hale concludes that isorropesis is the cause of color in the aromatic as well as the aliphatic series. In both series he considers the two modifications that must always be "in statu nascendi" to have actually been shown to exist. "The change of linking therefore, that must accompany the transformation of one into the other is certainly to be considered as the source of the oscillations which give rise to the vibrations in the ether of a free period corresponding to those in the visible region of the spectrum and hence the development of color in the substance."

The foregoing is in brief the most important of the theories advanced in regard to color and its relation to structure. As indicated by the great difference in the essential as well as in the minor details of the theories, the subject is far from closed. The field is intensely interesting and promises important developments.

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CHAPEL HILL, N. C.

TIMBER RESOURCES OF ORANGE COUNTY, N. C.*

BY J. S. HOLMES

Orange, with an area of 247,040 acres, is one of the middle eastern Piedmont counties. It lies between Durham on the east and Alamance on the west, both of which were originally part of this county.

Lying on the eastern edge of the granite formation and on the western border of the old "Triassic Sea," the topography of Orange is rougher and more broken than most of the other counties in this part of the State. Several low rocky ridges run part way across the county in an easterly and westerly direction, and close to Hillsboro are some hills, which rise several hundred feet above the town. The northeastern part of the county is drained principally by Eno and Little rivers, which uniting in Durham County with Flat River, form the head of the Neuse. The western part is drained by several creeks which flow southwesterly into Haw River, which when augmented by the waters of New Hope Creek, which drains the southeasterly part of the county, becomes the Cape Fear River. The streams are too small to form water powers of any size, though two or three small saw and grist mills are run by water power.

The soil varies from sandy and gravelly to a stiff red clay. An area of sandy loam varying in width from two to five miles crosses the northern part of the county. On this land tobacco is being grown in increasing quantities. A small area of sandy land also occurs near the southwestern corner of the county. Except along the southeastern border, where much of the soil is a yellowish gravelly clay, most of the rest of the county has a heavy red clay soil. Cotton and the cereals are the chief crops.

Approximately 40 per cent of the land area is now cleared. Of this cleared land nearly one-fifth is neglected and unused, and is gradually reverting to forest growth. There are no large timber tracts, and only seven per cent of the land is held by parties who own over 500 acres. An average assessed value for

* Reprinted from Press Bulletin No. 116 of the N. C. Geol. and Econ. Survey.

land is from $5 to $6 per acre. Its sale value runs from $10 to $20 per acre, and in the tobacco growing section considerably higher.

The North Carolina division of the Southern Railway runs through the county from east to west, while a ten-mile branch runs south to connect Chapel Hill with the main line. The wagon roads are at present very inadequate, though with the money secured by the recent issuance of bonds, a system of graded and surfaced main roads is now being constructed. There is, at present, little attempt, either amongst the population or on the part of the county authorities, to keep up the small crossroads; and these are in a serious condition. At present Orange County's best markets are at Mebane and Graham to the west and at Durham to the east. There is, as yet, no cash market at Hillsboro. Outside of the cotton mills at Hillsboro and Carrboro, little manufacturing is done. A factory at Efland makes excelsior from pine wood; while one or two small firms manufacture hickory handles and shuttle blocks. An attempt is also being made to produce cedar oil from the sawdust and twigs of the cedar.

The forests of Orange, which occupy 58 per cent of the county, are divided almost equally between hardwood and the old field pine types. It is estimated that these forests support an average stand of 620 feet of timber per acre, or a total stand of nearly 90,000,000 feet. Of this amount approximately 51 per cent is second-growth pine; 46 per cent oak; one per cent cedar; about one-half per cent each of poplar and "forest" pine; and the balance chiefly hickory. There is also thought to be as much as 3,000 cords of merchantable dogwood in the county.

The hardwood forests occupy the rougher and poorer areas, such as the hills, ridges, and broken country in the middle and southern parts of the county. There are also considerable areas of what are commonly called post oak flats. Most of the hardwood forest has been cut-over, some of it very closely, but here and there are found small tracts of merchantable oak, running from 2,000 to 5,000 feet to the acre, or even more. White oak and post oak are the principal merchantable trees, forming 80

per cent of the hardwood stand. The greater part of the oak timber is best adapted for the production of cross-ties; and this is the use to which it is being largely put. The red oaks, chiefly Spanish, black and scarlet oaks, form perhaps 15 per cent of the stand, while most of the remainder is hickory. There is very little poplar in Orange County, and less sweet gum. Though cedar occurs mostly in the old field pine type, some good merchantable cedar is found on some of the hardwood areas. It is said that no pine was originally mixed with the hardwoods in this county south of the sandy areas in north Orange. There is now, however, some merchantable pine in many hardwood areas, and pine seedlings and saplings are found coming in over perhaps the greater part of the hardwood forest.

The old field pine type occupies land which had at one time been cleared for agriculture, but which was subsequently abandoned. As a rule, therefore, it is more level and better adapted to farming than the hardwood land. It is estimated that about 15 per cent of this type contains merchantable timber, with an average stand of about 4,000 feet per acre. Practically all of this timber is second-growth pine, though many areas contain a percentage of cedar. Probably 60 per cent. of the pine forests are pole stands, the trees being below merchantable size.

Three species of pine occur in commercial quantities in Orange County. Shortleaf forms from 50 to 100 per cent of the pine stand throughout the county and in all but three townships—Chapel Hill, Eno, and Hillsboro—more than 95 per cent of it. In these three townships, constituting the southeastern third of the county, loblolly pine occurs plentifully; in the former township, between 30 and 40 per cent of the pine being of this species, while in the two latter about 15 per cent is loblolly. In the southern part of Bingham Township also about 10 per cent of the pine is of this species. The proportion of loblolly pine in the young growth is usually greater than it is in the merchantable timber, showing that this species is gaining ground in Orange. Scrub or "spruce" pine only occurs in any quantity in the northwestern quarter of the county where in two townships it forms about 5 per cent of the pine stand.

A few isolated patches are found also in the other northern townships.

The stumpage value of timber varies according to the distance from the railroad. Pine is worth from $2 to $2.50 per thousand, while cedar brings about $5. Oak stumpage varies from $2 to $3.50 per thousand. Some sales of mixed pine and hardwood have been made at as low a price as $1 per thousand for both pine and oak.

Lumbering on a large scale has ceased in Orange County. Though the total cut last year exceeded eight and three-quarter million feet, not more than one-half dozen mills exceeded a cut of 500,000, and no mill cut as much as a million feet. Fifty-four sawmills, of which thirty are small stationary mills cutting chiefly for local customers, operated last year. These cut approximately 4,000,000 feet of oak over one-half of which went into ties, 3,300,000 feet of old field pine, 1,000,000 feet of cedar, and 350,000 feet of "forest" pine. This makes an average annual cut of about 160,000 feet per mill.

For the past two years, and especially since the fall of 1912, when the failure of the crops made it necessary for the farmers to earn some extra money, the production of cross-ties has been an important industry. During 1913 it is estimated that at least 200,000 ties were cut and marketed, probably 75 per cent of them being hewn. This means a cut of about three ties per acre from all the hardwood land in the county and a money yield to the farmers exceeding their receipts for the cotton crop. Cross-ties delivered at the railroad have been selling at from 50 to 55 cents each for first class ties and 35 to 40 cents for second class ties.

It costs 10 cents per tie to have them sawn by a local mill, or 12½ cents each to get them hewed, while 2 cents per tie per mile will cover the cost of hauling. Stumpage prices range from 7½ cents to 10 cents per tie. It can be seen then that where the roads are good and the distances not too great, owners of tie timber can market it profitably at present prices. And they are certainly doing it.

Though landowners oppose burning the woods, yet through carelessnes or indifference a good many fires of greater or less

extent do occur nearly every year. As a rule, little timber is injured, though sometimes a good deal of cedar is killed. The chief damage, however, is to the young pine growth, which ought to be encouraged, not only in the pine type, but even more so in the hardwoods. In cutting timber, owners should endeavor to leave seed trees of pine, in order to increase the percentage of pine in the next crop. The spread of the loblolly pine should be assisted in every way possible, while, in the northeastern part of the county, the scrub pine should be cut in order to give the other species an opportunity to fill up the ground. At the present rate of cutting the old growth timber will soon be gone and the pine, because of its rapid growth, must be the main dependence for the future.

CHAPEL HILL, N. C.

WORK AT THE BEAUFORT LABORATORY

BY W. C. GEORGE

The work carried on annually at the Bureau of Fisheries laboratory at Beaufort, North Carolina, is of interest not only to scientific men generally but is of especial interest to biologists and others in North Carolina who are concerned in any way with the natural history of the State. And so it seems fitting to give in this place some account of the work carried on at the laboratory during the past season. There is no intention on the part of the writer to announce results or to encroach in any way upon the special reports on this work; but to give only such an account as might be given by a scientifically trained visitor of the laboratory.

The abundance and variety of the fauna and flora of the Beaufort region, together with the laboratory facilities provided by the Bureau of Fisheries, afford opportunity for a great diversity of biological work there, and every season there are a number of investigators at the Beaufort station carrying on varied and important researches. Only a brief reference will be made to the work of each of those who worked at the laboratory during the summer of 1913.

Professor S. O. Mast, of Johns Hopkins University, carried on an extensive investigation on the behavior of fishes with respect to conditions of light. It was already known that the background on which fishes lie greatly affects the arrangements of the pigment cells in the skin, and thus fish assume a very different appearance on one background from that which they have on another. For Dr. Mast's experiments the flounders proved very good subjects with which to work; and with some very ingeniously devised aquarium arrangements he has already reached interesting results and has learned something further in regard to the responses of animals to light.

Dr. W. P. Hay, Professor of Biology in the Washington City High School, was engaged in a study of the decapod crustacea of the region. Some years ago Dr. C. A. Shore, of Raleigh, collected during several summers the larger crustacea, particu-

larly crabs and shrimps, of Beaufort harbor; but through press of other work he was not able to complete his study of these forms. Dr. Hay is carrying on this investigation and will before long have an amply illustrated paper, which will enable any one to identify the crabs and shrimps of the region. These forms are of such general interest to fishermen and amateur collectors and naturalists that the paper will be extensively used by visitors to our coast.

Dr. J. J. Wolfe, Professor of Biology in Trinity College, was engaged in botanical work for the Bureau. Few people except naturalists are aware of the immense number of minute plants and animals that float at or near the surface of the sea. This flora and fauna, known as the plankton, constitute the food of most young fishes, and in every quarter of the world some effort is being made to determine just what forms are present, and to learn something about their movements and propagation. Dr. Wolfe is occupied in a study of the microscopic plants, especially the diatoms. Another investigator, Dr. Edmundson, of the University of Oregon, was engaged in a study of the microscopic fauna, the protozoa. These are groups which have practically never been studied along the South Atlantic coast and so their study should yield fruitful results.

Dr. H. V. Wilson, Professor of Zoology in the University of North Carolina, was engaged in a study of the Philippine sponges. Some years ago the Bureau of Fisheries undertook an extensive survey of the waters in the neighborhood of the Philippine Islands. Large collections of the various zoological groups were made, and the collections of these groups were handed out to numerous specialists to be reported on. The collection of sponges is very large and contains representatives of all the sub-divisions of the group. It was upon a study of these forms that Professor Wilson was engaged.

The work of Mr. L. F. Shackel, of the St. Louis School of Medicine, was with the ship-worms. Among the animals that are destructive of property along our coast none is more troublesome than the ship-worm. This is really not a worm at all but a bivalve mollusc. In very young stages they begin to burrow

into wood. They excavate wharf piles, boat timbers, etc., and do very great damage. Mr. Shackel is carrying on investigations which have for their object the determination or invention of new ways for preventing these animals from entering wood.

In addition to this more general biological work the Bureau is carrying on detailed work on the fishes. Considerable attention has already been paid to the fishes, but the group is so important that the most detailed knowledge of it is desirable. And so the director of the laboratory, Mr. Lewis Radcliffe, with the help of a number of assistants, is constantly making collections and observations on the group. A few years ago a book on the North Carolina fishes, by Dr. H. M. Smith, now chief of the Fisheries Bureau, was published by the North Carolina Survey. Mr. Radcliffe and others have been able to add a number of forms to those already recorded. And what is of even greater importance, they are learning more about the life histories of the Beaufort fishes. Dr. Albert Kunz, of the University of Iowa, studied the development of a number of the more abundant forms. This is a field not only of scientific but of great economic interest and importance. The eggs of these fish are very small and float at the surface of the water, and may be captured in fine meshed nets. With the aid of an accomplished artist, Mrs. Decker, of Washington, D. C., some very beautiful figures of the stages in the development of these forms have been made.

Mr. H. F. Taylor, of the Tarboro City Schools, was engaged in work on fish scales to discover if the age of fishes might be determined thereby.

Besides a general study of a number of forms, my own work was mostly in following the phenomena of reduction in the medusæ of Pennaria. Every evening just at dusk during the breeding season the mature medusæ of Pennaria come off from the colony. They swim about in the water for a time casting the eggs and sperm, and then they settle down to the bottom and begin to degenerate. In this process of reduction the medusæ pass through some interesting stages which it was my purpose to follow. The work has not yet been completed.

Aside from the more purely scientific work, the laboratory is engaged in breeding Diamond Back Terrapins, an enterprise of direct economic importance. The object of this work is the elaboration of methods for artificially rearing the Diamond Back Terrapin. The success of the work is already such that it is now possible to breed these terrapins for the market, and private parties in Beaufort have built breeding pens and have started the work on a commercial basis. The breeding experiments, which are under the supervision of Dr. W. P. Hay, are still being continued.

CHAPEL HILL, N. C.